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400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE

AMS 4148C

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Superseding AMS 4148B

Submitted for recognition as an American National Standard

ALUMINUM ALLOY DIE FORGINGS
5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr (7175-T66)
Solution and Precipitation Heat Treated

UNS A97175

1. SCOPE:

1.1 Form:

This specification covers an aluminum alloy in the form of die forgings and forging stock.

1.2 Application:

These forgings have been used typically for parts requiring a high level of mechanical properties, but usage is not limited to such applications.

- 1.2.1 Certain design and processing procedures may cause these forgings to become susceptible to stress-corrosion cracking; ARP823 recommends practices to minimize such conditions.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

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2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

- AMS 2201 Tolerances, Aluminum and Aluminum Alloy Bar, Rod, Wire, and Forging Stock, Rolled or Cold Finished
- MAM 2201 Tolerances, Metric, Aluminum and Aluminum Alloy Bar, Rod, Wire, and Forging Stock, Rolled, Drawn, or Cold Finished
- AMS 2355 Quality Assurance Sampling and Testing, Aluminum Alloys and Magnesium Alloys, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings
- MAM 2355 Quality Assurance Sampling and Testing, Aluminum Alloys and Magnesium Alloys, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings, Metric (SI) Units
- AMS 2808 Identification, Forgings
- ARP823 Minimizing Stress-Corrosion Cracking in Wrought Heat-Treatable Aluminum Alloy Products

2.2 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

- ASTM B 594 Ultrasonic Inspection of Aluminum Alloy Products for Aerospace Applications
- ASTM B 660 Packaging/Packing of Aluminum and Magnesium Products

2.3 U.S. Government Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

- MIL-H-6088 Heat Treatment of Aluminum Alloys
- MIL-STD-6866 Inspection, Liquid Penetrant

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

Shall conform to the percentages by weight shown in Table 1, determined in accordance with AMS 2355 or MAM 2355.

TABLE 1 - Composition

Element	min	max
Zinc	5.1	6.1
Magnesium	2.1	2.9
Copper	1.2	2.0
Chromium	0.18	0.28
Iron	--	0.20
Silicon	--	0.15
Manganese	--	0.10
Titanium	--	0.10
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

3.2 Condition:

(R)

The product shall be supplied in the following condition:

3.2.1 Forgings: Solution and precipitation heat treated in accordance with
(R) MIL-H-6088.

3.2.2 Forging Stock: As ordered by the forging manufacturer.
(R)

3.3 Properties:

(R)

The product shall conform to the following requirements, determined in accordance with AMS 2355 or MAM 2355:

3.3.1 Forgings:

3.3.1.1 Tensile Properties: Shall be as follows:

3.3.1.1.1 With Grain Flow: Specimens, machined from forgings 3 inches (76 mm) and under in nominal thickness or from prolongations on such forgings, with axis of specimen in area of gage length varying not more than 15 degrees from parallel to the forging flow lines, shall have the properties shown in Table 2.

TABLE 2 - Minimum Tensile Properties

Property	Value
Tensile Strength	86.0 ksi (593 MPa)
Yield Strength at 0.2% Offset	76.0 ksi (524 MPa)
Elongation in 2 Inches (50.8 mm) or 4D	7%

- 3.3.1.1.2 Across Grain Flow: Specimens, machined from forgings 3 inches (76 mm) and under in nominal thickness or from prolongations on such forgings, with axis of specimen in area of gage length varying not more than 15 degrees from perpendicular to the forging flow lines shall have the properties shown in Table 3. If the configuration of the forging or prolongation cannot accommodate the transverse specimen described, acceptance of the forgings shall be based on testing as in 3.3.1.1.3.

TABLE 3 - Minimum Tensile Properties

Property	Value
Tensile Strength	77.0 ksi (531 MPa)
Yield Strength at 0.2% Offset	66.0 ksi (455 MPa)
Elongation in 2 Inches (50.8 mm) or 4D	4%

- 3.3.1.1.3 At Angle to Grain Flow: Specimens, machined from forgings 3 inches (76 mm) and under in nominal thickness or from prolongations on such forgings, with axis of specimen in area of gage length varying more than 15 degrees from parallel and also more than 15 degrees from perpendicular to the forging flow lines, shall have the properties specified in 3.3.1.1.2. Such test results shall be identified as neither longitudinal nor transverse tensile properties.
- 3.3.1.1.4 Tensile property requirements, with, across, and at an angle to the grain flow for forgings over 3 inches (76 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.
- 3.3.1.1.5 Elongation requirements shall not apply to specimens having a gage length diameter under 0.250 inch (6.35 mm), or located in immediate proximity to an abrupt change in section thickness, or located so that any part of the specimen gage length is located within 1/8 inch (3.2 mm) of the trimmed flash line.
- 3.3.1.2 Hardness: Should be not lower than 140 HB/10/500 or 145 HB/10/1000 but forgings shall not be rejected on the basis of hardness if the tensile property requirements are met.
- 3.3.1.3 Grain flow of die forgings, except in areas which contain flash-line end grain, shall follow the general contour of the forgings showing no evidence of re-entrant grain flow.
- 3.3.2 Forging Stock: When a sample of stock is forged to a test coupon having a degree of mechanical working not greater than the forging and heat treated in the same manner as forgings, specimens taken from the heat treated coupon shall conform to the requirements of 3.3.1.1 and 3.3.1.2. If specimens taken from the stock after heat treatment in the same manner as forgings conform to the requirements of 3.3.1.1 and 3.3.1.2, the tests shall be accepted as equivalent to tests of a forged coupon.

3.4 Quality:

Forgings, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the forgings.

3.4.1 Forgings shall be subjected to a caustic etch followed by visual examination of the forging surfaces for defect indications such as seams, laps, bursts, and quench cracks. Surface imperfections which can be removed so that they do not reappear on re-etching and the required section thickness can be maintained are acceptable.

3.4.1.1 When approved by purchaser, a sampling plan may be used in lieu of etching each forging.
(R)

3.4.2 When specified, forgings shall be subjected to ultrasonic inspection in accordance with ASTM B 594 and shall meet the following requirements of that specification:

3.4.2.1 Forgings 0.500 to 4.000 inches (12.70 to 101.6 mm), inclusive, in nominal thickness and weighing not over 300 pounds (136 kg) shall meet Class B.

3.4.2.2 Acceptance criteria for forgings exceeding the limits of 3.4.2.1 shall be as established by purchaser.
(R)

3.4.3 When specified, forgings shall be subjected to fluorescent penetrant inspection in accordance with MIL-STD-6866. Standards for acceptance shall be established by the cognizant engineering organization.
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3.5 Tolerances:

(R)

Forging stock shall conform to all applicable requirements of AMS 2201 or MAM 2201.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

(R)

The vendor of the product shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conform to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests for composition (3.1), tensile properties (3.3.1.1), surface visual examination (3.4.1), and, when specified, ultrasonic inspection (3.4.2) and fluorescent penetrant inspection (3.4.3) are acceptance tests and shall be performed on each lot.
(R)

4.2.2 Periodic Tests: Tests of forgings for hardness (3.3.1.2) and grain flow (3.3.1.3) and of forging stock to determine ability to develop required properties (3.3.2) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.
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